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SOME THEORIES OF VISUAL SPACE

by

AUGUST WILLIAM WEBER

A Thesis Submitted for the Degree of

MASTER OF PHILOSOPHY

UNIVERSITY OF WISCONSIN

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C O N T E N T S.

Introduction

Berkeley

Hume

Kant

Herbart

Lotze

Wundt

Bain & Mill

James, Ward, Stumpf

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SOME THEORIES OF VISUAL SPACE.

The problem to be considered, in this dissertation, is the nature of our primitive space perceptions. Are our sight sensations at first non-spatial and are then spacialized by an act of the mind or is the primary experience one of expansion?

Prior to the time of Berkley, not much had been done with the subject. The ancients held the view that in sense-perception the primary qualities, such as form, and the secondary, such as color, were immediately apprehended. Democritus supposed that in perception emanations of things penetrate through the organs of sense, giving rise to presentations. Aristotle recognized that figure and magnitude were perceptibles not peculiar to one sense, as are color and sound, but he was far from the modern psychological problem of space as is seen from his co-ordination of the perceptions of extension and color, regarding each as a real quality in things. In modern times, Descartes regarded extension as external and forming the real nature of bodies, but he seems to have contributed nothing as to the way in which the mind perceives this extension. With Locke, our idea of space is derived

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from sight and touch. He held that we perceive by sight, directly, a distance between bodies of different colors and between parts of the same body. But not until Berkeley's time, do we find any achievement of note in the study of space perception.

In his New Theory of Vision, he undertook to show that sight was incompetent to give us, directly, perceptions of distance; that our apparently immediate visual intuitions were a product of experience and association, the interpretation of a visual language. He starts out from the assumption that distance or depth is necessarily invisible for, says Berkeley,"distance, being a line directed endwise to the eye, it projects only one point in the fund of the eye - which point remains invariably the same, whether the distance be longer or shorter." In some of the latter sections of the New Theory of Vision, he appears to hold that not only depth but even superficial extension is invisible. He says e. g. in § 158 "From all which we may conclude that planes are no more the immediate object of sight than solids. What we strictly see are not solids nor yet planes variously colored - they are only diversity of color."

Distance being invisible and yet perceived by sight, it must be suggested to the mind"by some other idea which is itself perceived in the act of seeing." This is brought

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about by certain arbitrary signs, such as organic sensations in the eye which become associated with various tactual sensation in our experience. "I believe whoever will look narrowly into his own thought and examine what he means by saying he sees this or that thing at a distance will agree with me, that what he sees only suggests to his understanding that, after having passed a certain distance, to be measured by the motion of his body, which is perceivable by touch, he shall come to perceive such and such tangible ideas which have been usually connected with such and such visible ideas." The service of the sight sensations is merely that of signs, which are ignored when those sensations are aroused, which they signify. He says in "Divine Visual Language § 12: "Signs, being little considered in themselves, or for their own sake, but only in their relative capacity and for the sake of those things whereof they are signs, it comes to pass that the mind overlooks them, so as to carry its attention immediately on to the things signified. Thus, for example, in reading we run over the character with the slightest regard, and pass on to the meaning. Hence it is frequent for men to say, they see words, and notions, and things in reading of a book; whereas in strictness they see only the characters which suggest words, notions, and things. And, ny parity of reason, may we not suppose

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that men, not resting in, but overlooking the immediate and proper objects of sight, as in their own nature of small moment, carry their attention onward to the very things signified, and talk as if they saw the secondary objects? which, in truth and strictness, are not seen, but only suggested and apprehended by means of the proper objects of sight, which alone are seen."

Moreover, there is no perceivable object common to sight and touch. Berkeley holds that light and color are the only immediate objects of sight and these are not perceptible to the sense of touch, so that prior to experience, no one could, possibly, anticipate, from the visual impression of an object, anything about its felt size, shape or position, or from feeling of it, anything about its visual appearance.

Berkeley really did not go beyond the visual problem and as far as one can tell regarded the tactual intuition of space as immediate and requiring no explanation.

Turning now to Hume, to see what he has to offer on the derivation of space, we find his account, following upon Berkeley, rather meagre.

He says: "the first notion of space and extension is derived solely from the senses of sight and feeling."[1] Since every idea, according to Hume, must be the copy

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1. Bk. I, Part IV, sec. V.

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of an impression and since "no impression is presented by the senses as the image of anything distinct or external or independent,"[1] no idea can be so presented and there is therefore no distinction possible between space and the idea of it, save liveliness, and hence the idea of extension must be extended. This he admits in so many words in Part IV, sec. V: "To say the idea of extension agrees to anything is to say it is extended." The derivation referred to must mean either that space, at first, is simply a visual or a tactual feeling, or a compound result of both. The latter is impossible on his atomistic view of the mind. If the former, applying his own criterion to this which he applies to substance, "if it be perceived by the eyes it must be a color; if by the ears a sound; if by the palate a taste; and so on of the other senses,"[2] It follows that space is either a color or feeling or touch.

Hume considers the nature of space particularly in relation to its supposed infinite divisibility. This divisibility he denies, as necessarily he must, on his conception of mind. The ultimate elements of experience must be real units capable of being represented or imagined in isolation. Space, as we have just seen, is an extended idea from which the unit of space is derived by division. Thus he says:[3] "Now 'tis certain we have an

1. Part IV, sec. II.
2. Part I, sec. VI.
3. Part II, sec. II.

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idea of extension; for otherwise why do we talk and reason concerning it? 'Tis likewise certain, that this idea, as conceived by the imagination, tho' divisible into parts or inferior ideas, is not infinitely divisible, nor consists of an infinite number of parts: For that exceeds the comprehension of our limited capacities. Here then is an idea of extension, which consists of parts or inferior ideas, that are perfectly indivisible: consequently this idea implies no contradiction: consequently 'tis possible for extension really to exist conformable to it."

For Hume, these units of space can not be extended for that would fail to give an explanation of space, since he cannot identify it with an impression or set of impressions. They are, consequently, unextended but they are not mathematical points. They are extended points, upon which color or solidity has been bestowed. Thus he says:[1] "It has often been maintained in the schools, that extension must be divisible, in infinitum, because the system of mathematical points is absurd; and that system is absurd, because a mathematical point is a non-entity, and consequently can never by its conjunction with others form a real existence. This would be perfectly decisive, were there no medium betwixt the infinite devisibility of matter, and the non-entity of mathematical points. But there is evidently a medium, viz: the bestowing of color

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1. Part I, sec. IV.

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or solidity on these points; and the absurdity of both the extremes is a demonstration of the truth and reality of this medium." The mode of arrangement of these colored points is the idea of space. Thus he says:[1] "The table before me is alone sufficient by its view to give me the idea of extension. This idea, then, is borrowed from, and represents some impression, which this moment appears to the senses. But my senses convey to me only the impression of colored points, DISPOSED IN A CERTAIN MANNER.[2] If the eye is sensible of anything farther, I desire it may be pointed out to me. But if it be impossible to show anything farther, we may conclude with certainty, that the idea of extension is nothing but a copy of these colored points, and of the manner of their appearance." Here, Hume has failed to give an account of the idea of space that is in accordance with his principle, that ideas are but fainter copies of impressions, for order of disposition cannot be an impression; he has substituted colored points for color; he begs the question by assuming a space in which to arrange the colored points; and fails to offer any explanation of how coexistence can be a possible element of cognition in a conscious experience made up of independent elements.

Thus the attempt to explain space as a mode of arrangement of inextended points proves futile. For

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1. Part II, sec. III.
2. The capitals are the writer's, not Hume's.

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Kant space is "not an empirical notion derived from external experience, for external experience is itself possible only by means of the representation of space." That is to say we cannot derive space from the objects we perceive because it is already implied in them. It is a constituent of the very experience itself, as ultimate or more so than any other. Space is not a thing in itself that is something existing independently of the mind. "Space itself, however, as well as time, and with them all phenomena are not things by themselves, but representations, and cannot exist outside of our mind."[1] The purpose of the antinomies of pure reason with regard to space is to show that to speak of space as a thing in itself leads to an absurdity. Both the affirmative and the negative of the limitations or non-limitations of the universe with regard to space can, according to Kant, be proved with equal cogency. He thus showed that the thesis and antithesis rested upon the false assumption, that space was a thing in itself, and we must therefore limit space to a purely subjective significance. "If we regard the two statements that the world is infinite in extension, and that the world is finite in extension, as contradictory opposites, we assume that the world (the whole series of phenomena) is a thing by itself; for it remains, whether I remove

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1. Transcendental Dialectic, Bk. II, chap. II, sec. VI.

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the infinite or the finite regressus in the series of its phenomena. But if we remove its supposition, or this transcendental illusion, and deny that it is a thing by itself, then the contradictory opposition of the two statements becomes purely dialectical, and as the world does not exist by itself (independently of the regressive series of my representations), it exists neither as a whole by itself infinite, nor as a whole by itself finite. It exists only in the empirical regressus in the series of phenomena, and nowhere by itself. Hence, if that series is always conditioned, it can never exist as complete, and the world is therefore not an inconditioned whole, and does not exist as such, either with infinite or finite extension."[1] There may be things in themselves but they are absolutely unknowable. "The objects of experience are never given by themselves but in our experience only and do not exist outside it."

Space, for Kant, is a form of perception. We are given extended sense qualities and these the mind clothes, as it were, with space and time. He says: "Space is nothing but the form of all phenomena of the external senses; it is the subjective condition of our sensibility, without which no external intuition is possible for us."[2]

Since pure form is never realized in experience there

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1. Transcendental Dialectic, Bk. II, chap. II, sec. III.
2. Ibid , Part I, sec. I.

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can be no empty space for Kant. And it is to this effect that he says: "If therefore all reality in perception has a certain degree, between which and negation there is an infinite succession of ever smaller degrees and if every sense must have a definite degree of receptivity of sensations, it follows that no perceptions, and therefore no experience, is possible, that could prove, directly or indirectly, by any round-about syllogisims, a complete absence of all reality in a phenomenon.We see therefore that experience can never supply a proof of empty space or empty time, because the total absence of reality in a sensuous intuition can itself never be perceived, neither can it be deduced from any phenomenon whatsoever and from the difference of degree in its reality; nor ought it ever to be admitted in explanation of it."[1]

Moreover if space is a law in experience the problem of its divisibility must be restated. There can be no discussion of dividing space,but rather of dividing objects in space or the distance between objects that is the space relations of objects. Infinite divisibility, for Kant, means that as long as an object is an object it must be in space, however far the division may be carried on. "As in all phenomena pure intuition is either space or time every phenomena, as an intuition, must be an extensive

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1. Transcendental Analytic, Bk. II, chap. II, sec. III.

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quality."[1]

The fundamental error in Kant's treatment of space lies in the fact that he makes space a perception instead of a conception. He seems to take sensations as complete in space and time before the categories are reached. This assumption appears again and again in the Critique although he denies it in words. If space could be given in perceptions apart from the categories then space would be a form of perception, but perceptions are not independent of conceptions. The simplest perception involves a whole line of categories. Kant's proof for considering space a perception is that space "is essentially one, any plurality of parts or units in it (consequently also the general notion of spaces) rests solely on limitations of itself." But a unitary idea is not necessarily a perception --reality, for example, is a notion. Kant says that "space is represented as an infinite quantity." But quantity is an abstract notion, and if space is given as quantity it must be conceived and not perceived, nor could an infinite quantity be perceived. Kant failed to distinguish between our concrete spatial experiences and the general conception of space derived from them.

These two views so far considered, the Berkeley-Hume and the Kantian, may be said to have indicated the way for the later psychologists. In general, these fall into

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1. Transcendental Analytic, Bk. II,, chap. II,, sec. III.

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two classes:one considers space as an ultimate element and is generally referred to in Germany as Nativists; the other holding the empiristic or genetic theory. The emperistic, or psychical stimulists,as Prof. James calls them, in one sense, may be called followers of Kant, in that they make space a supersensational mental product; in another sense, they may be called Berkeleyans in as much as their theory is derivative. According to this theory, space is derived from a number of elementary experiences, among which the feelings, which accompany the action of the muscles of the eye, play an important part. The locality which we give to the various retinal impressions is not original but built out of moter experiences.

This view is held in a greater or less degree by Herbart,Lotze, Wundt, Helmholtz, Volkmann, Lipps, Mill, Bain and others. Herbart's peculiar theory may be said to have given the impulse to empirical investigation.

For Herbart, the idea of space arises from an association among states of consciousness. According to him all presentations are successive and only become ordered in the form of space when they constitute a reversible series. He says: "The first representations fall successively and are fused gradually with those that follow. But upon the least return backward, these earlier representations come back en masse, are raised (above the threshold) by

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means of those which are there added and which resemble them. It thus happens that each representation assigns its place to all the others, since it must place itself beside and among them.[1]

James says of this: "The obvious objection is that serial order is a genus and that, if the terms of reversible series become by that fact coexistent terms in space, the musical scale, the degrees of warmth and cold, and all other ideally graded series ought to appear to us in the shape of extended agregates,- which they notoriously do not, though we may of course symbolize their order by a spatial scheme."[2] And Ribot says: "This has given occasion to Lotze to object to this theory, that certain series can be read indifferently, from up down or from down up, without giving the least idea of space; and to other critics, who have maintained that this derivation of space itself previously implied the idea of space."[3]

Lotze's theory of visual localization is characterized by his doctrine of local signs. He does not attempt to explain the empirical genesis of the intuition of space. "It is not at all our project," says Lotze, "from these local signs to deduce the soul's faculty of perceiving space in general, nor the necessity it is under of appre-

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1. Psychologic als Wissenschaft, pp. 119-120.
2. Prin. of Psychol, Vol. II, p. 276.
3. Ribot's German Psychology of To-day, p. 39.

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hending the thing felt in the notional category. We presuppose, on the contrary, that there are in the nature of the soul grounds by reason of which it is not only capable of a notion of space, but is further compelled to apply this notion to the content of sensation, and we seek to explain by hypothetical physiological relations, between the local signs, neither this faculty nor this compulsion. Yet, while we accept and hold as a fact to be recognized from the first, that the soul is able to form these ideas of space and consents to it; it remains to ask further on what principle, in this general idea of space, its discrimination is guided in assigning one sensation to such a place and another to another, and how it is led to regard the sensations a and b as contiguous, the sensations a and c as remote in their relation to each other."[1] The intuition of space is assumed as an original fact beyond explanation, but is not to him an entity prior to experience. He says: "We must not imagine that, before the soul receives external impressions, it spreads out, like a net ready to catch anything that falls into it, the intuition of infinite space of three dimensions entirely formed and already complete."[2]

Each part of the skin, each part of the retina gives, to the impression received, a particular mark, the local

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1. Medicinische Psychologie, Bk. II, sec. 292.
2. Revue Philosophique, Nov. 1887, vol. II, p. 345.

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sign, which differentiates it from other impressions. At first,the stimulation of any point of the retina is followed by a movement bringing this stimulus on the centre of the yellow spot. This movement gives rise to a definite mode of feeling which differs from other modes where movements are carried out. Later on, when two or more points are simultaneously and equally stimulated and no movement follows, the feelings of movements, previously experienced, cling to the impressions and thus the eye learns to localize the various impressions even in a state of repose. "It is from the combination of the excitations of the retina with those unconscious impressions which associate with them, in the soul, tendencies to movement, that we may deduce the co-ordination of points in the field of vision."[1] These local signs have, for Lotze, no spacial quality and must first be interpreted by the constructive mind. Why he considers these local signs necessary and the mind unable to interpret the sensations directly, he failed to explain.

Wundt considers Lotze's simple system of local signs as inadequate to account for our construction of spatial ideas. To Lotze's feeling of innervation, he adds the local sign which distinguishes any point of the retina from every other point. But neither local impression alone

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1. Medicinsche Psychologie, sec. 328.

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nor movement alone can give localization in space. He says:[1] "In the eye, space-perception has certain constant peculiarities which prove that no single optical sensation by itself possesses the extensive form but that everywhere in our perception of space heterogeneous feelings combine. If we simply suppose that luminous sensation per se feel extensive, our supposition is shattered by that influence of movement in vision which is so clearly to be traced in many normal errors in the measurement of the field of view. If we assume, on the other hand, that the movements and their feelings are alone possessed of the extensive quality, we make an unjustified hypothesis, for the phenomena compel us, it is true to accord an influence to movement, but give us no right to call the retinal sensation indifferent, for there are no visual ideas without retinal sensations. If then we wish vigorously to express the given facts, we can ascribe a spatial constitution to combination of retinal sensations with those of movement." From the psychical synthesis of these sensational elements, qualitative local signs of the retina and intensive sensations of movement, which in themselves have no spatial quality, he derives space. In his Logik, he says: "The process of space-perception may be briefly described as a measuring of the manifold local-sign system of the retina by the simple local-sign system of the

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1. Logik, p. 457.

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movements. In its psychological nature this is a process of associative synthesis; it consists in the fusion of both groups of sensations into a product, whose elementary components are no longer separable from one another in our immediate idea. In melting wholly away into the product which they create they become consciously undistinguishable, and consciousness apprehends only their resulting product, the perception of space. Thus there obtains a certain analogy between this psychic synthesis and that chemical synthesis which out of simple bodies generates a compound that appears to our immediate perception as a homogeneous whole with new properties."

In his Outline of Psychology, p. 129, he says: "The whole process of visual space-arrangement is then due to the fusion of these different sensational elements: first, the sensational qualities depending upon the character of the external stimulus, second, the qualitative local signs, depending on the places where the stimuli act, and third, the intensive motor sensations, determined by the relation of the stimulated points to the centre of the retina. The latter elements may either accompany actual movements - this is the original case - or, when the eye remains at rest, are mere motor impulses of a particular intensity." Here there is apparently an element added, "the sensational qualities depending upon the character of the external stimulus," but it is more

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reasonable to suppose that this is understood in the quotation before cited. Sully writes in Mind, vol. III, p. 186: "The visual perception of space is then regarded by Wundt as a product of the same mental process (synthesis of peripheral sensation and central feelings of innervation) as the tactual perception. What distinguishes the former from the latter is the reference of this complex of sensations to a single point, the retinal centre."

The "mental chemistry" of the Associationists, represented by Bain, Mill and others, is practically identical with Wundt's psychical synthesis. Says Bain:[1] "The conclusion, therefore, is that extension, size or magnitude, owes, not only its origin but its essential import, or meaning, to a combination of different effects associated together under the cohesive principle we are now considering. Extension, or space, as a quality, has no other origin and no other meaning than the association of these different sensitive and motor effects. The coalition of sensations of sight and of touch with felt motor energies, explain everything that belongs to our notion of extended magnitude or space."

Wundt's theory admits that we cannot analize the spatial quality in consciousness, but merely asserts that the antecedents are psychical. It is hard to see how

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1. The Senses and Intellect, p. 372.

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psychical elements having no spatial quality should by fusion produce it. Schurman, in Phil. Review, vol. VIII, and James, in Prin. of Psychol., suggests that they have forgotten Locke's precept, that the mind can frame unto itself no new simple idea. James asks pertinently, in speaking of Wundt's theory, "Why talk of 'genetic theory' when we have in the next breath to write as Wundt does: "If then we must regard the intuition of space as a product that simply emerges from the conditions of our mental and physical organization, nothing need stand in the way of our designating it as one of the a priori functions with which consciousness is endowed." He also questions the motor feelings of innervation which according to Wundt differ only in intensity. He says:[1] "There is no introspective evidence of the feeling of innervation. Wherever we look for it and think we have grasped it, we find that we have really got a peripheral feeling or image instead - an image of the way in which we feel when innervation is over and the movement is in process of doing or is done."

Bain and Mill admit the weakness of their theory. Thus Prof. Bain says; if movement feelings give us any property of things, "it would seem to be not space, but time" and John Mill, "the idea of space is, at bottom one

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1. Prin. of Psychol., p. 499.

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of time".[1] These statements on the part of Bain and Mill clearly indicate the inadequacy of our experience of movement, upon which the associationists lay so much stress, to account for the origin of the idea of space.

E. Montgomery in Mind, vol. X, p. 230, writes thus about psychical synthesis: "As far as I am aware, no investigator of psychophysical phenomena has yet made quite clear to himself that 'psychical synthesis,' as such, is a mere imaginary fiction, with no more possibility of actual existence than fire works in a vacuum. Veritable synthesis has in every instance to be first organically established, before it can at all manifest itself as a mental phenomena. We cannot therefore correctly speak of a psychical genesis of a space perception either by dint of transcendental spontaneity or out of experimental data; but must seek to understand the confluence of organic faculties and vital events that render the appearence of such a thoroughly synthetic product possible."

The remaining school, we shall here consider, of which James, Ward, and Stumpf are the chief representatives, considers space an ultimate sensational element. James' voluminousness, which Ward calls extensity, is as much an element in each sensation as is intensity.

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1. Senses and Intellect, p. 183.
   Ex. of Hamilton, p. 283.

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Says James:[1] "Now my first thesis is that this element discernible in each and every sensation, though more developed in some than in others, is the original sensation of space, out of which all the exact knowledge about space that we afterwards come to have, is woven by processes of discrimination, association, and selection." Again he says:[2] "It is impossible to lie on one's back on a hill, to let the empty abyss of blue fill one's whole visual field, and to sink deeper and deeper into the merely sensational mode of consciousness regarding it, without feeling that an indeterminate, palpitating, circling depth is as indefeasibly one of its attributes as its breadth." Ward says: "The first condition of spatial experience seems to lie in what has been noted above as the extensity of sensation. This much we allow is original; for the longer we reflect the more clearly we see that no combination or association of sensations varying only in intensity and quality, not even if motor presentations are added will account for the space element in our perceptions."[3] And Hering writes:[4] "We must distinguish roomy from superficial, or well as distinctly from indistinctly bounded, sensations. The dark which with closed eyes one sees before one is , for example,

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1. Prin. of Psychol., p. 135.
2. Ibid, p. 212.
3. Encyclop. Britannica, article Psychology.
4. Hermann's Handb. d. Phyol., Bd. III. 1, S. 572.

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a roomy sensation. We do not see a black surface like a wall in front of us, but a space filled with darkness, and even when we succeed in seeing this darkness as terminated by a black wall there still remains in front of this wall the dark space. The same thing happens when we find ourselves with open eyes in an absolutely dark room. This sensation of darkness is also vaguely bounded. An example of a distinctly bounded roomy sensation is that seen not only on the bounding surface of the glass; the yellow sensation fills the whole interior of the glass. By day the so-called empty space between us and objects seen appearsvery different from what it is by night. The increasing darkness settles not only upon the things but also between us and the things, so as at last to cover them completely and fill the space alone. If I look into a dark box, I find it filled with darkness, and this is seen not merely as the dark-colored sides or walls of the box. A shady corner in an otherwise well-lighted room is full of a darkness which is not only on the walls and floor but between them in the space they include. Every sensation is there where I experience it, and if I have it at once at every point of a certain roomy space, it is then a voluminous sensation. A cube of transparent green glass gives me a spatial sensation; an

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opaque cube painted green, on the contrary, only sensation of surface."

After having considered the vague form or quale of spatiality as an inseparable element in all of our sensations, James discusses spatial order. The primitive perceptions are without order, which however they include potentially, but which is not distinctly apprehended by the mind until woven into them.

He says: "There is no reason to suppose that the several sense-spaces of which a sentient creature may become conscious, each filled with its own peculiar content should tend, simply because they are many, to enter into any definite spatial intercourse with each other, or lie in any particular order of positions. Even in ourselves we can recognize this. Different feelings may exist in us without assuming any particular spatial order. The sound of the brook near which I write, the odor of the cedars, the comfort with which my breakfast has filled me, and my interest in this paragraph, all lie distinct in my consciousness, but in no sense outside or alongside of each other."[1] Consciousness must divide, measure, and add together these chaotic spaces and make out of them the regular and orderly world of space. Says James: "The bringing of subdivisions to consciousness

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1. Prin. of Psychol., p. 146.

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constitutes, then, the entire process by which we pass from our first vague feeling of a total vastness to a cognition of the vastness in detail. The more numerous the subdivisions are, the more elaborate and perfect the cognition becomes. But inasmuch as all the sub-divisions are themselves sensations, and even the feeling of more or less is, where not itself a figure, at least a sensation of transition between two sensations of figure, it follows for aught we can as yet see to the contrary, that all spacial knowledge is sensational at bottom and that, as the sensations lie together in the unity of consciousness, no new material element whatever comes to them from a supra-sensible source."

How we arrive at the conception of space is best stated in his own words: "All our sensations are positively and inexplicably extensive wholes. The sensations contributing to space-perception seem exclusively to be the surface of the skin, retina, and joints. Muscular feelings play no appreciable part in the generation of our feelings of form, direction, etc. The total bigness of a cutaneous or retinal feeling soon becomes subdivided by discriminative attention. Movements assist by reason of the peculiarly exciting quality of the sensations which stimuli moving over surfaces arouse.

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1. Prin. of Psychol., p. 152.

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Subdivisions, once discriminated, acquire definite relations of position towards each other within the total space. These relations are themselves feelings of the subdivisions that intervene. When these subdivisions are not the seat of stimuli, the relations are only reproduced in imaginary form. The various sense-spaces are, in the first instance, incoherent with each other; and primitively both they and their subdivisions are but vaguely comparable in point of bulk and form. The education of our space-perception consists largely of two processes - reducing the various sense-feelings to a common measure, and adding them together into the single all-including space of the real world. Both the measuring and the adding are performed by the aid of things. The imagined aggregate of positions occupied by all the actual or possible, moving or stationary, things which we know, is our notion of real space - a very incomplete and vague conception in all minds."[1] Space perceptions may then be said to be obtained like colors or sounds and the notion of space derived from them by abstraction.

In this theory, voluminousness or extensity has been more or less criticised. Bradley says: "What has been called extensity appears to me to involve a confusion. When you know what you mean by it, it seems to turn out to

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1. Prin. of Psychol., pp. 268-269.

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be either spatial at once and downright, or else not spatial at all. It seems useful, inpart, only as long as you allow it to be obscure."[1]

Wundt says: "For an undefined spatial perception, as has been assumed sometimes, in which only the general form of the side-by-side (nebeneinander) without any localization (raumesbestimmung) of the separate objects to one another is given, is a fiction, possessing as little, reality as a time order without content."[2]

Hobhouse, on the other hand, says:[3] "I see extension as I see color. There is no more reason to say that I see the color and construct the extension, than to suggest that I am given the extension and lay on the color. The two characteristics of the whole are distinguished only by an act of abstraction. As given, they are indivisible. Nor is this all. What I really see is not a blue surface merely, but a deep vault at a distance from myself, and into which I seem to see. In short, it is not surface only but volume."

Again he says: "We never see an unextended object, we never touch one. From the beginning so far as self-observation or memory can inform us, we are given objects extended in space. . . . . No sense-content definitely known to me as extended is also known, or can be remem-

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1. Bradley, Appearance and Reality, p. 35.
2. Gundzuge der Physiol. Psyschol, p. 130.
3. Theory of Knowledge, p. 343.

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bered, as being given in an unextended form."

It has also been said of this theory even if this primitive spatial quality of sensations is admitted, it does not contribute anything to the explanation of the visual perception of space, since these ultimate elements must be modified and supplemented by experiential knowledge. This is the main criticism found in the resume from Helmholtz as quoted by Ribot in his German Psychology of To-Day: "1st. The theory of nativism seems to introduce an unnecessary hypothesis. 2nd. Its results give, in accounting for space, notions that rarely accord with fact. The advocates of this theory are obliged to admit against themselves that their original sensations of space may be modified, or indeed, replaced by knowledge furnished in experience. 3rd. It is hard to see that these original sensations of space can contribute anything to the explanation of visual perception, since the advocates of this theory are compelled to admit that, in the great majority of cases, these sensations must be supplemented by very profound experiential knowledge. If this is necessary, it seems simpler and easier to admit that all notions of space are furnished by experience only, without having first to combat innate notions which are false in most cases." Hobhouse, on the other hand, says: "It is in accordance with all analogy to suppose

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that our knowledge of space progresses from the vague to the definite, and how vague its beginning may be we cannot well say."[1]

We have thus considered the four main lines of visual space perception. The Berkeley-Hume theory, as we have seen, practically leaves the question unsolved. With Kant, space is a product of the mind for the envelopment of non-spatial elements; with Wundt, a product generated in the mind by non-spatial elements; with James, "a first psychical thing" which enters with the first visual sensations. The spatial quality is according to Wundt an original psychical element, but according to James, an original sensationl element; with the former, it results from the fusion of psychical elements, with the latter, it is no further analyzable.

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1. Theory of Knowledge, p. 47.

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